

MOSFETs Silicon N-Channel MOS

# SSM6N56FE

### 1. Applications

· High-Speed Switching

### 2. Features

- (1) 1.5-V gate drive voltage.
- (2) Low drain-source on-resistance

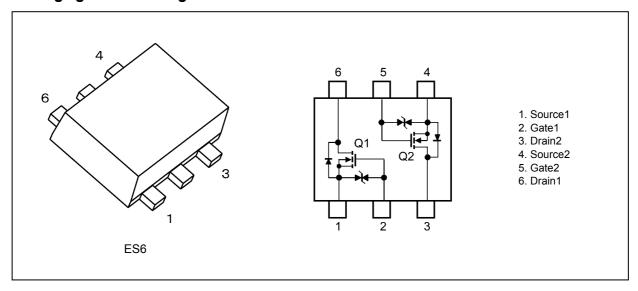
 $: R_{DS(ON)} = 235 \text{ m}\Omega \text{ (max) } (@V_{GS} = 4.5 \text{ V}, I_D = 800 \text{ mA})$ 

 $R_{DS(ON)}$  = 300 m $\Omega$  (max) (@V<sub>GS</sub> = 2.5 V,  $I_D$  = 600 mA)

 $R_{DS(ON)} = 480 \text{ m}\Omega \text{ (max) (@V_{GS} = 1.8 V, I_D = 200 mA)}$ 

 $R_{DS(ON)}$  = 840 m $\Omega$  (max) (@V\_{GS} = 1.5 V,  $I_D$  = 50 mA)

### 3. Packaging and Pin Assignment





# 4. Absolute Maximum Ratings (Note) (Unless otherwise specified, T<sub>a</sub> = 25 °C) (Q1,Q2 Common)

Characteristics		Symbol	Rating	Unit
Drain-source voltage		$V_{DSS}$	20	V
Gate-source voltage		V <sub>GSS</sub>	±8	
Drain current (DC)	(Note 1)	I <sub>D</sub>	800	mA
Drain current (pulsed)	(Note 1)	I <sub>DP</sub>	1600	]
Power dissipation	(Note 2)	P <sub>D</sub>	150	mW
Power dissipation	(Note 3)		250	]
Channel temperature		T <sub>ch</sub>	150	°C
Storage temperature		T <sub>stg</sub>	-55 to 150	

Note: Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) are within the absolute maximum ratings.

Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook ("Handling Precautions"/"Derating Concept and Methods") and individual reliability data (i.e. reliability test report and estimated failure rate, etc).

- Note 1: Ensure that the channel temperature does not exceed 150 °C.
- Note 2: Device mounted on an FR-4 board.(total dissipation) (25.4 mm  $\times$  25.4 mm  $\times$  1.6 mm ,Cu pad: 0.135 mm<sup>2</sup>  $\times$  6)
- Note 3: Device mounted on an FR-4 board.(total dissipation) (25.4 mm  $\times$  25.4 mm  $\times$  1.6 mm ,Cu pad: 645 mm<sup>2</sup>)

Note: The MOSFETs in this device are sensitive to electrostatic discharge. When handling this device, the worktables, operators, soldering irons and other objects should be protected against anti-static discharge.

Note: The channel-to-ambient thermal resistance, R<sub>th(ch-a)</sub>, and the drain power dissipation, P<sub>D</sub>, vary according to the board material, board area, board thickness and pad area. When using this device, be sure to take heat dissipation fully into account.

### 5. Electrical Characteristics

### 5.1. Static Characteristics (Unless otherwise specified, T<sub>a</sub> = 25 °C)(Q1,Q2 Common)

Characteristics		Symbol	Test Condition	Min	Тур.	Max	Unit
Gate leakage current		I <sub>GSS</sub>	$V_{DS} = 0 \text{ V}, V_{GS} = \pm 6 \text{ V}$	_	_	±1	μА
Drain cut-off current		I <sub>DSS</sub>	V <sub>DS</sub> = 16 V, V <sub>GS</sub> = 0 V	_	_	1	
Drain-source breakdown voltage		V <sub>(BR)DSS</sub>	I <sub>D</sub> = 1 mA, V <sub>GS</sub> = 0 V	20	_	_	V
Drain-source breakdown voltage	(Note 1)	V <sub>(BR)DSX</sub>	I <sub>D</sub> = 1 mA, V <sub>GS</sub> = -5 V	15	_	_	
Gate threshold voltage	(Note 2)	V <sub>th</sub>	$V_{DS} = 3 \text{ V}, I_{D} = 1 \text{ mA}$	0.4	_	1.0	
Drain-source on-resistance	(Note 3)	R <sub>DS(ON)</sub>	$I_D = 50 \text{ mA}, V_{GS} = 1.5 \text{ V}$	_	360	840	mΩ
			$I_D = 200 \text{ mA}, V_{GS} = 1.8 \text{ V}$	_	290	480	
			$I_D = 600 \text{ mA}, V_{GS} = 2.5 \text{ V}$	_	230	300	
			I <sub>D</sub> = 800 mA, V <sub>GS</sub> = 4.5 V	_	186	235	
Forward transfer admittance	(Note 3)	Y <sub>fs</sub>	V <sub>DS</sub> = 3 V, I <sub>D</sub> = 200 mA	_	1.4		S

Note 1: If a reverse bias is applied between gate and source, this device enters  $V_{(BR)DSX}$  mode. Note that the drain-source breakdown voltage is lowered in this mode.

Note 2: Let  $V_{th}$  be the voltage applied between gate and source that causes the drain current ( $I_D$ ) to below (1 mA for this device). Then, for normal switching operation,  $V_{GS(ON)}$  must be higher than  $V_{th}$ , and  $V_{GS(OFF)}$  must be lower than  $V_{th}$ . This relationship can be expressed as:  $V_{GS(OFF)} < V_{th} < V_{GS(ON)}$ .

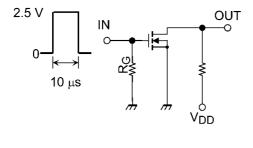
Take this into consideration when using the device.

Note 3: Pulse measurement.

### 5.2. Dynamic Characteristics (Unless otherwise specified, T<sub>a</sub> = 25 °C)(Q1,Q2 Common)

Characteristics	Symbol	Test Condition	Min	Тур.	Max	Unit
Input capacitance	C <sub>iss</sub>	V <sub>DS</sub> = 10 V, V <sub>GS</sub> = 0 V,	_	55		pF
Reverse transfer capacitance	C <sub>rss</sub>	f = 1 MHz	_	6		
Output capacitance	Coss		_	16		
Switching time (turn-on time)	t <sub>on</sub>	$V_{DS}$ = 10 V, $I_{D}$ = 200 mA,	_	5.5	_	ns
Switching time (turn-off time)	t <sub>off</sub>	$V_{GS} = 0 \text{ to } 2.5 \text{ V}, R_{G} = 50 \Omega$	_	8.5		

### 5.3. Switching Time Test Circuit



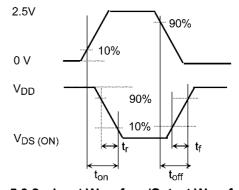


Fig. 5.3.1 Switching Time Test Circuit

Fig. 5.3.2 Input Waveform/Output Waveform

### 5.4. Gate Charge Characteristics (Unless otherwise specified, T<sub>a</sub> = 25 °C) (Q1,Q2 Common)

Characteristics	Symbol	Test Condition	Min	Тур.	Max	Unit
Total gate charge (gate-source plus gate-drain)	Qg	$V_{DS}$ = 10 V, $I_{D}$ = 800 mA,	_	1.0		nC
Gate-source charge 1	Q <sub>gs1</sub>	$V_{GS} = 4.5 \text{ V}$	_	0.12		
Gate-drain charge	Q <sub>gd</sub>		_	0.4		



# 5.5. Source-Drain Characteristics (Unless otherwise specified, T<sub>a</sub> = 25 °C) (Q1,Q2 Common)

Characteristics		Symbol	Test Condition	Min	Тур.	Max	Unit
Diode forward voltage	(Note 1)	$V_{DSF}$	$I_D = -0.8 \text{ A}, V_{GS} = 0 \text{ V}$		-0.82	-1.2	V

Note 1: Pulse measurement.

### 6. Marking

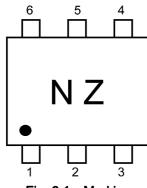


Fig. 6.1 Marking

### 7. Characteristics Curves (Q1,Q2 Common) (Note)

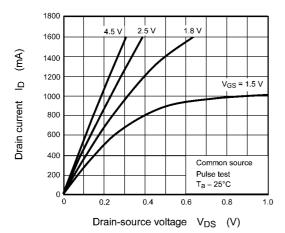


Fig. 7.1 I<sub>D</sub> - V<sub>DS</sub>

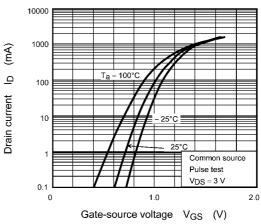


Fig. 7.2 I<sub>D</sub> - V<sub>GS</sub>

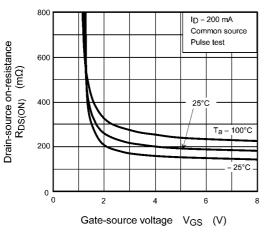


Fig. 7.3  $R_{DS(ON)}$  -  $V_{GS}$ 

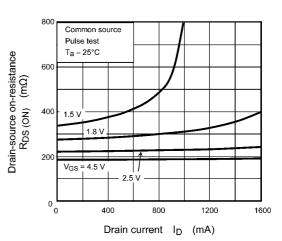


Fig. 7.4  $R_{DS(ON)}$  -  $I_D$ 

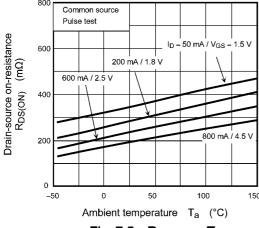


Fig. 7.5 R<sub>DS(ON)</sub> - T<sub>a</sub>

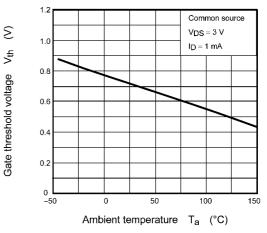
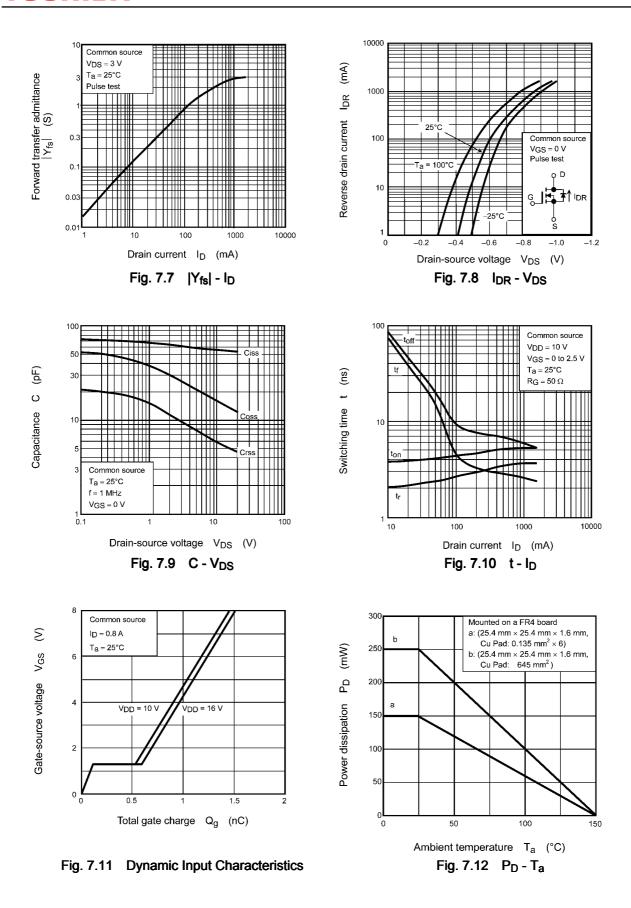


Fig. 7.6 V<sub>th</sub> - T<sub>a</sub>

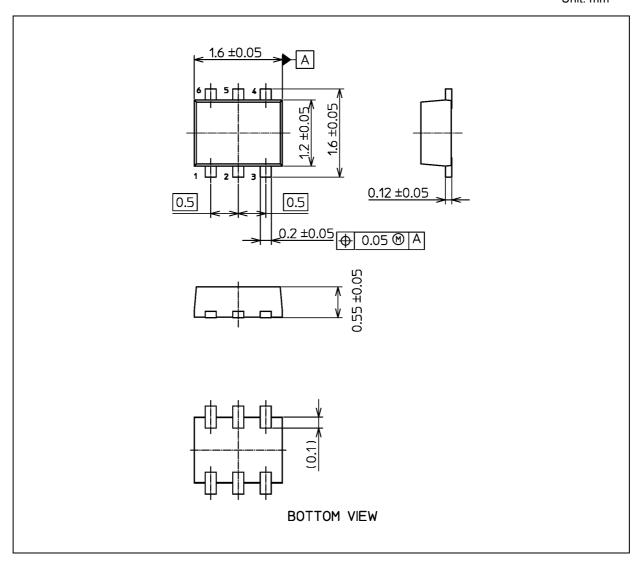


Note: The above characteristics curves are presented for reference only and not guaranteed by production test, unless otherwise noted.



### **Package Dimensions**

Unit: mm



Weight: 3.0 mg (typ.)

	Package Name(s)	
Nickname: ES6		



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